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ABSTRACT

This paper discusses the concept of information literacy as the main framework within which the concept of computer literacy may be defined, describes in detail the design of a complete curriculum in information literacy intended for all students in elementary and junior high schools, and provides an example of this design with a specific learning unit for grade 6 entitled "Information in-Formation." This curriculum is part of a larger program entitled MABAT, the Hebrew acronym for Science in a Technological Society. The unit comprises four chapters: (1) The World of Information; (2) Information Processing; (3) Information Processing in the Human Brain; and (4) The Computer--An Information Processing Machine. Materials for the unit are briefly described, including a textbook containing various activities and reading excerpts, models to be built and operated, games, computer software, enrichment notebooks, and kits for assembly. The development of both this unit and an independent parallel project, the computer simulation "The Transparent Computer," and status of the unit at the time this report was written are briefly described. Appended materials include an outline of a proposed course for grades 1-9, Man Coping within an Information Society, and the syllabus for the Information in-Formation course. (EW)

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INTRODUCTION

The history of technology reflects, to some extent, human history. Tools and machines are part and parcel of human evolution, and man is constantly using them to shape his environment. In each era, technology plays a major role in determining the nature of the contemporary culture (Bolter,1984). The fact that he is both mortal and social being, underlies man's role in passing on the accumulated knowledge and culture from generation to generation. This role gives man the status of Teacher, and his tools thus acquire the status of educational means and contents (McLuhan, 1967; Weizenbaum, 1976).

The contemporary period clearly exemplifies the impact of technological innovation on both individual and society (McLuhan, 1964; Bell, 1979; Forester, 1980). It has been termed Information Society (Bell, 1979); The Electronic Age (McLuhan, 1967); The Third Information Revolution (Simon, 1977), and The Computer Age (Dertouzos, 1979). The common denominator of all these terms is the Information Technology.

Unlike technological innovations in the past, current technology is changing very fast (Abelson & Hammond, 1977). It has only been 40 years since the introduction of the first electronic computer. Today information technology is everywhere - industry, services, defence, entertainment and home. The enormous changes in both individual and social institutions impose heavy demands on the new types of knowledge and skills, which must become an integrated part of the individual's basic education.

Being able to cope with information in this environment requires the ability to select, store and retrieve required information. The new jobs created by the Information Industries require vocational education which did not exist in the past. Adaptation to changes in the mode of operation of traditional social institutions requires understanding and relating to these changes which depend on developing pertinent attitudes and skills. The availability of the technology to the individual, in his immediate environment, requires careful handling and mastery, in order to prevent the abuse and misuse of these powerful tools.

The need for the traditional curriculum to change and adapt to these new needs is widely recognized, and its importance is emphasized by a series of reports and papers (Licklider 1979, Klassen 1981, Chen and Nachmias 1983). Nevertheless, educational institutions move very slowly, compared to the speed with which information technology is changing and molding our lives.

In the late seventies, the feasibility of using information technology for educational purposes has created, for the first time, an awareness of the need of introducing new elements into the formal curriculum. Such elements should enable the wide-scale preparation of future citizens to life in the Information Age.

Two major levels of teaching were usually adopted: the first involved introducing computer science as a subject, mainly in high schools and vocational education. The other involved introducing it as "computer literacy", which would enable the entire population of students to interact with computers adequately. It is this second approach which interests us in the present paper. There are different versions with regard to the scope and sequence of computer literacy courses (Chen & Nachmias, 1983). According to Luherman's definition (1980), computer literacy is intended to

give the student "the control over the computer", namely, the skills and knowledge necessary to use it freely. While we feel that this is probably an indispensable part of modern education, it is most definitely not a sufficient measure to enable the graduate of schools in the 1990s, to meet the demands of the information age.

The present paper describes the concept of "Information Literacy", as the main framework within which the concept of "computer literacy" may be defined. We will describe in detail the design of a complete curriculum in Information Literacy, inteded for all students in elementary and junior high schools, and we shall illustrate this design with a specific learning unit, titled "Information in-Formation".

This curriculum, which was developed by the Tel Aviv University Science Teaching Center, is a part of a larger program, titled "MABAT" (the Hebrew acronym for Science in a Technological Society), which will be integrated as a part of the national science curriculum in 1985.

I. THE DESIGN OF THE COURSE: MAN COPING WITHIN AN INFORMATION SOCIETY.

Central to the project "Science in a Technological Society" is the relationship between man and environment, emphasizing the extension of man's natural capabilities via technology (Chen & Novik, 1984). "Man coping with Information Society" is a major segment of the above curriculum. It is intended for all students in the educational system, which enables its inclusion in the curriculum of compulsory education (grades 1 to 9).

The objectives of the program are:

1. Understanding the very nature of information as a human and technological phenomenon.

2. Understanding the social and technological implications of information society.

3. Mastering basic concepts and skills necessary for using the new technologies.

4. Creating awareness of the potential and limits of the new technologies.

Underlying the design of the curriculum is the approach which draws on Information Science as the body of knowledge and skills required in order to generate, communicate and utilize information (Weiss, 1977).

Appendix 1 presents the major concepts, which were divided into four categories:

1. Generation and organization of information . This category deals with the ways in which knowledge and information are created and codified (Cognition and perception; symbol systems; writing and numbering systems; data collection; models; simulations; algorithms; etc.).

2. Information transfer and distribution . This describes the process by which information is communicated among the individuals comprising a given population (live populations, machines, or a combination of the two). Two sub-categories of classification are differentiated, according to the purpose of such transfer:

A. Communication: Here are concepts such as the formation of a communication circuit; means of communicating information; interpersonal communication and mass communication; man-machine communication, etc.

B. Storage and data processing: This includes concepts such as information

storage, means for storing information; memory; information processing; the activity of the brain; the computer units, etc.

3. Means and applications: This refers to the identification of means (instruments, technologies) and the practical expression of information systems in social life, e.g. symbol systems, measuring and computing instruments; means of communication, communication technologies, decision making processes, education technologies, art, etc.

4. Effects and influences: The social phenomena in which information systems play a major role, such as: the evolution of language, the print, electronic devices, education, mass communication, the management of complex social organizations; propaganda and advertising; leisure culture; social centralization and de-centralization; etc.

The contents have been arranged hierarchically, according to the age level, and a content-related focus has been determined for each level. The rationale for the planning and the detailed mapping appear elsewhere (Mioduser, 1982).

For further elucidation of the multiplicity of curricular, cognitive and organizational problems related to the development of this project the grade 6 level learning unit "Information in-Formation" was developed. This unit will be described in greater detail in the following sections.

II. "INFORMATION IN-FORMATION": A LEARNING UNIT FOR GRADE 6

This learning unit focuses on the various stages of information processing, as it takes place in everyday life, performed by the human brain, and with the aid of computers.

The objectives of the unit:

A. The student should know and understand the stages of information processing: input - processing - output.

B. The student should be able to describe daily phenomena in terms of the process: input-processing-output.

C. The student will experience processes of problem solving and decision making, and will be able to identify and describe these activities in terms of input-processing-output.

D. The student will learn how information is being processed by the human brain.

E. The student will understand that man has built machines, the speed and accuracy of which help in information processing.

F. The student will learn and understand the information processing by computers.

G. The student will develop a positive attitude towards modern technologies, through understanding the logic of the structure, mode of operation, capabilities and limitations of information processing systems.

1. The Principles Underlying the Development of the Learning Unit:

Content Principles:

A. Technology as an extension of the natural capabilities of man: Information processing technologies are perceived as an extension of the human nervous system,

serving to increase man's capabilities in performing activities unique to him, namely, the activities of the human brain. The unit presents the information processing as it is carried out in the human brain and by machines built by man to help in performing these activities.

B. The influence of technology on the life of individual and society: The various roles of information, and the changes introduced into the life of individuals and the society at large as a result of the development of information technologies, are illustrated by the unit through the presentation of a variety of examples for information processing and the application of computers in daily living.

C. The discipline and related skills: The unit centers around the basic concepts of information processing and the technologies by which man is helped in processing information, as well as the intellectual and motor skills involved in applying this.

Curricular Principles:

A. Acquisition of skills through experience: The proposed activities involve experiencing the use of a variety of skills which the unit wishes to teach. These include intellectual skills (for example: selection among alternatives, problem solving; organization and retrieval of information) and motor skills (beginning with model building and up to operating a computer).

B. Representation of the Immediate Environment of the Learner: The topics of the activities are derived from the immediate, relevant, environment of the student: home, school, the apartment house, the city. There is also reference to information derived from newspapers, children literature, activities at school, etc.

C. Variate instruction methods: The contents of the unit are taught thorugh various means: texts for reading, games, building and assembling models, operating

these models, keeping a diary, newspaper reviews, interaction with the computer, etc.

D. Self-Teaching: The unit enables the individual learner to advance independently. The presentation of the various topics, instructions for performing the activities, instructions and examples for keeping the diary and components of the models to be built - all comprise a part of the textbook.

2. The contents of the unit

The unit is comprised of four chapters:

A. The world of information: This deals with identification of the roles of information in daily life: identification of the components of the physical environment which are related to dealing with information; the use of information by various role players; the role of information in decision making.

B. Information Processing: This chapter presents the basic concepts: input - processing - output; it also deals with identifying information processing in examples taken from daily life and discriminating between processes which people carry out in their brains and those performed through the aid of machines.

C. Information Processing in the Human Brain: This chapter focuses on the variety of information processing activities of the human brain, and the role of perception

and memory in such processing. It also employs the concepts of input - processing - output in the analysis of examples drawn from everyday life.

D. The Computer - An Information Processing Machine: This chapter introduces the structure and mode of operation of the computer, and the necessity of instructions by man for the operating of the computer; presenting the personal computer and its applications to daily life.

3. The structure of the unit

The unit is comprised of a textbook, containing various activities and reading excerpts, models that should be put built and operated, games, computer software, enrichment notebooks and kits for assembling (for details see Appendix 2).

The four chapters all have a similar structure: Each opens with a paragraph presenting the core of the chapter and the related problems. Two to three major activities follow (for example: operating a model, press review, games). Throughout the learning the student is requested to compile a "diary"; following each activity in the chapter, he is expected to perform various tasks in the Report Notebook. At the end of each activity and each chapter reading paragraphs are given, which summarize and elaborate on the learned topic. Finally, there is the "Chippie report", which summarizes the major concepts taught in the chapter.

Appendix 2 details the activities in each chapter, as well as the additional components of the learning unit.

4. The development of the unit

Two years were required to reach the present version of the unit, which includes models, games and computer software. The development has been accompanied by evaluation activities, including experiments in the classroom, carried out at various stages of the development, and consultations with experts in the various subject-matter areas, as well as in cognitive psychology and curriculum development. The present version is the final result of the above, and it will undergo systematic evaluation in the coming months.

An independent parallel project has been the development of the computerized simulation "The Transparent Computer", that deals with the contents of chapter four of the unit. The development of this project has taken a year and a half, and the present edition is the result of systematic experimentation and evaluation. Detailed description of the rationale and the implementation of this simulation in the classroom appear elsewhere (Mioduser, Nachmias & Chen, 1984). The enrichment booklets, audiovisual materials and kits for assembling (items 6,7,8 of Appendix 2) are currently under preparation.

SUMMARY

The knowledge and skills related to management of information and the use of information technology, and the awareness to the influence of the above technologies on the life of society at large, has become an essential component of the basic education of every individual. The formal education is accomplished through the years of compulsory education. It is during these years, therefore, that the educational system must equip the individual with the basic "Information Literacy", in order to ensure that each citizen has the minimal tools for adequate functioning in the information society. The curriculum for grades 1-9, "Man coping within an Information Society" is an attempt to cope with the contents, conceptual and organizational problems involved in equipping the population at large with this knowledge.

The learning unit for grade 6, "Information processing", is an attempt to cope with practical curricular issues involved in teaching these contents in the classroom. The results to date are encouraging, helping in establishing the basis on which the work will continue.

Appendix 1

MAN COPING WITHIN AN INFORMATION SOCIETY:Organization of the proposed course

GRADE	1. DATA GENERATION, ORGANIZATION, AND STORAGE	2. INFORMATION TRANSMITION AND PROCESSING
1-2	Properties of matter Classification-group theory and categorization. Measurements-sources of information.	Basic communications circuit Information transmission processes in the animal kingdom. Verbal and non-verbal description instruction and learning.
3	Signs and symbols (visual, acoustic, written, etc.) Language (spoken, written).	Means of information transfer: voice, body, noise, instruments, writing, etc. Verbal and non-verbal communication . Communication patterns among animals.
4	Data organization and classification: Coding-decoding, simple means of information storage, measurements, quantification, etc.	The input/processing/output cicle
5	Signs: conventions, supersigns, hierarchy, coding, bit chunking.	Transmitter/Means/Receiver/Noise Signal: electric pulse, acoustic and optic wave, printed character, etc. Photography-Recording.
6	Organization of simple information systems. The binary method. Advanced means of information storage.	Algorithm-Program Senses and memory (LTM, STM) Computer components and their functions.
7	Probability information quantification. Frequency redundancy. Formation of supersigns (via complex or category formation). Sources and motivation initiating communication processes.	Techniques in the arts. Techniques in advertising and propaganda. Language, Education, Memory Role of communications processes in the formation and functioning of social organizations
8	Flow chart-Pobability Model-Simulation Computer language Feedback	Man-machine communication Electrical circuit-Mechanical transmission Analog and digital principles.

Appendix 1 (cont.)

GRADE	3. INFORMATION SYSTEMS APPLICATION	4. OUTCOMES AND IMPLICATIONS
1-2	Various manifestations of the communication process in the environment. Simple measuring and calculating instruments. Trial and error method of problem solving. Carrying out instructions.	Perception of the environment: classification, organization Identification of functions in communication processes
3	Symbol systems Simple Codes: Morse, flag signals, etc. Means of interpersonal communication. Coding and Decoding.	Transition to written language History of information transmission Advent of printing.
4	Computation instruments: Simulation Simple computation instruments	Process optimization by using auxiliary means for calculating and computing.
5	Mass-communications Innovative "media" Communication occupations	"Media" and shape of society "The medium is the message" Extensions of Man
6	Information systems in the immediate environment (classroom, library, etc.)	Information explosion Optimization of the organization and management of information systems
7	Advertising and propaganda Education Arts Social organizations (animals and man)	Changing relationships of individuals and society Centralization and decentralization of social structures Change of occupation profile Education, Arts Culture of Leisure Shaping public opinion Advertising, propaganda
8	Information systems in the service of Man. Processes of decision-making Control Automatic regulation The interplay between the individual and information systems.	Decision-making processes in bureaucratic and democratic organizations Rearrangement of workforce (from manufacturing occupations to information handling) Leisure time

Appendix 1 (cont.)

GRADE 9

Project in one of the areas of the unit (e.g., information system for use in the classroom; "animation film"; planning a publicity campaign using several media, etc.)
The following components will be part of this unit:

1. Concepts and processes such as: "Intellectual Technologies", Decision-Making, Planning, etc.
2. Guidelines for project development:

2.1 Methodology: organization, planning, examples, etc.
2.2 Techniques: use of instruments and application of various technologies.
2.3 Reference to sources: consultation, information, equipment, etc.

CONTENT FOCUS

Grades 1 and 2 : Basic principles of communications and automatic computation.
Grades 3, 5 and 7: Communications and media.
Grades 4, 6 and 8: Computers and information processing systems.

MAIN THEMES FOR EACH GRADE

Grade	1-2	Fundumentals
Grade	3	Significance of communication
Grade	4	Use of simple aids for data classification and organization.
Grade	5	Mass communication.
Grade	6	Information processing.
Grade	7	Communication processes and the functioning of society.
Grade	8	Information systems ("Compunication") in a social context.

Appendix 2

INFORMATION IN-FORMATION: Organization of the learning unit.

1. THE SUBJECTS OF THE LEARNING UNIT

Chapter 1: The world of Information

The roles of information
Objects and instruments related to information
People who use information
The necessity of information
Information in decision-making

Chapter 2: Information Processing

The process of input-processing-output
The processing of information
Information processing in everyday living

Chapter 3: Information Processing in the Brain

The various roles of the brain in information processing
Examples for information processing in the brain

Chapter 4: Information Processing by the Computer

The computer as an extension of man's nervous system
The computer units and their roles
Program and programming language
The personal computer and its application to daily life

2. THE CONTENTS AND ACTIVITIES OF THE UNIT

Chapter 1: Information on using Information

(a) Information, pigeons and the weather	: Introduction: the role of information today
(b) Excavation in a thousand years	: Studying our information age through an archaeological enterprise 1000 years from now
(c) People use information	: A newspaper activity on uses of information in daily life
(d) The Mayor's decisions	: A decission making cards game (see items 4 and 5)

Chapter 2: Information in-formation

(a) A storm in a cocoa cup	: Introduction
(b) Materials getting processed	: Learning input/output/processing concepts through building and working with a "coining machine"
(c) The desperate detective and "Identi-kit 572"	: Building and operating a model (see item 3)
(d) Information getting processed	: Summary

Chapter 3: Please Use Your Brains

(a) The Coucil of the Wise Men	: Introduction
(b) Please use your brains	: A series of activities comprising: association, identification, memory, computation,etc.
(c) Our correspondent for brain affairs reports...	: text and discussion
(d) Info - An expert for information processing	: Game for building examples on information processing by the brain (see item 4)

Chapter 4: The Computer is No Wizzard

(a) Man built machine	: Introduction
(b) Chippie 572 - The forms-making machine	: (See item 3)
(c) It´s your turn to program Chippie 572	: "Programming the forms making machine" (or "The transparent computer", a computerized simulation - see item 5)
(d) A computer is no wizzard	: Summary

3. MODELS

On Chapter 2: "Identi-kit 572" (A machine for information processing)
A model for composing faces on the basis of the binary principle
On Chapter 4: Chippie 572 - The forms-compiling machine
A model of a computer and its operation. Includes the various units of the computer. May be programmed to compile various forms, and demonstrate the stages of performing the program step-by-step, up to the final output stage.

Appendix 2 (cont)

4. GAMES

On Chapter 1: The Mayor´s decisions:
A decision-making game, involving decisions on issues concerned with daily life in town.

On Chapter 3: Info - An expert for Information Processing
Puzzle of illustration of information processing in the brain. The students has to provide examples of affective and cognitive activities that lead from an observed input (a card he choices) to the output.

5. COMPUTER SOFTWARE

On Chapter 1: The Mayor´s decisions (in planning):
A computerized decison-making game. In adddition to the game included in the book, it includes:
- additional branching
- various levels of clues and information purchase
- graphic screens
- rich interactive activity

On Chapter 4: "The Transparent Computer": A simulation of the computer´s units and its mode of operation (developed in 1984):
A computerized simulation which may be programmed using a limited language. While running the program it is possible to follow the order of performance of the statements, the transition of statements and numbers among the different units, the changes occurring in the various units throughout the performance of the program and the various stages leading to the output.

6. INFORMATION BOOKLETS (in planning)

On Chapter 1: Articles and papers from newspapers on the issues of the development of the computer and information technologies, their application and uses in daily life, etc.

On Chapter 3: Reading cards on the topics: The Brain, Memory Tree, Nervous System

On Chapter 4: The history of the computer, from the abacus up to the actual and prospected developments

7. AUDIOVISUAL AIDS

On Chap. 1-2: The Information Society
A movie describing the applications of modern technologies to daily life. Composed of two parts:

A. The development of information technology: A short review, beginning with the alphabeth and the abacy, and up to the computer.
B. The application of computers in daily living, and the prospects of future development.

8. BUILDING KIT (in development)

On Chapter 4: Build your own "processing machine":
Assembling models of the various units of the machine:

- binary adder
- memory unit
- screen or some visual output

Including a manual with explanations, and the materials for assembling the models.

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